6

Chromosome Numbers of Heliconiine Butterflies from Trinidad, West Indies (Lepidoptera, Nymphalidae)

(Figures 1-4; Tables 1-2)

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Haploid numbers are given for all 14 of the Heliconiine butterflies found in Trinidad. Eleven have been examined in other parts of their range, and show no geographical variation in chromosome number. Three species show variation within or between individuals. *Heliconius melpomene* and *H. erato* vary so much in their color pattern that they are usually split into several species; there is no accompanying variation in chromosome number. Classification of the subfamily by karyotype matches well with the conventional classification. Most of the genera and subgenera have n = 28 to n = 31, which is typical of butterflies, but the very numerous subgenus *Heliconius* (*Heliconius*) has, with a few exceptions, n = 21. The chromosome numbers of all species in the subfamily examined by these and other authors are tabulated. The three previously unreported species are *Philaethria dido, Heliconius ethilla,* and *H. ricini* (all n = 21).

INTRODUCTION

MUCH IS NOW KNOWN about the physiology, ecology, genetics, behavior, and geographical distribution of the butterflies belonging to the predominantly Neotropical subfamily Heliconiinae; most of the recent papers have been published in this journal. This paper reports the chromosome numbers of all the 14 species found in Trinidad, West Indies. Four of these species, *Philaethria dido, Heliconius ricini, H. ethilla,* and *H. wallacei* have not been examined before; the remaining ten Trinidadian species all have been examined, in other parts of their range by de Lesse (1967) and by Maeki and Remington (1961). (Since this paper went to press de Lesse (1970b) has examined *H. wallacei* from Guyane, formerly French Guiana).

METHODS

Testes were taken from adult males and ovaries with mature eggs from old adult females. They were fixed in Carnoy's fluid (6:3:1), embedded in paraffin via butyl alcohol and sectioned at a thickness of 10 μ (testes) or 15 μ (ovaries). The preparations were stained by the Feulgen method.

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RESULTS

Haploid chromosome numbers for all the Trinidadian species are given in Table 1, with de Lesse's data from other parts of Spanish America, Maeki and Remington's from México, and Emmel's data from Costa Rica for comparison. The 11 species investigated both in Trinidad and in other parts of their range show no geographical variation of chromosome number, but *H. aliphera, H. isabella,* and *H. doris* show variation within or between individuals. Figures 1-4 show the chromosomes of the four species not previously described.

The use of the name *H. ethilla* (Godart) requires some explanation; in most other recent papers on this group, the species is known as *H. numata* (Cramer) (see for example Beebe, Crane, and Fleming, 1960, and Turner, 1968a). The change of name to *ethilla* results from the revision by Emsley (1965), and the extensive revision of this section of the genus by Brown (1972). De Lesse (1967) reports the chromosome number of a species from Colombia which he calls *H. ethilla;* Dr. K. S. Brown, Jr. (personal communication) has kindly identified this as *H. hecale melicerta* Bates.

All other names quoted are used in the same sense as in the many papers on this group appear-

ing in *Zoologica,* and illustrated by Beebe *et al.* (1960) and Emsley (1963) (see Turner, 1967, for a note on the complicated tangle over the names *doris, erato,* and *vesta*). Authors are cited in Table 2.

Discussion

The lack of geographical variation in the chromosome numbers of the species *Heliconius erato* and *H. melpomene* is worth noting because both show such remarkable geographical variation of the wing pattern (illustrated in color by Turner, 1970, 1971) that most taxonomists have split them into several species (Neustetter, 1929). Table 1 shows that four distinct subspecies of *melpomene* (*H. m. melpomene* from Trinidad and Colombia, *H. m. thelxiope* from Guyane, *H. m. plesseni* from Ecuador and *H. m. rosina* from Costa Rica), representing four very different color patterns, all have the same chromosome number. Similarly the same chromosome number is found in five distinctly marked subspecies of *H. erato* (*H. e. hydara* or *guarica* from Trinidad, Guyane, and Colombia; *H. e. erato* from Guyane; *H. e. venustus* from Bolivia; *H. e. phyllis* from Argentina; and *H. e. petiverana* from México and Guatemala). Thus the evolution of elaborate differences of pattern in these two species has not been accompanied by any change in chromosome numbers (see Turner, 1971, for a discussion).

In Table 2, the subfamily is classified according to the haploid chromosome numbers. Several interesting facts emerge. The subgenus *Heliconius* (*Heliconius*) consistently has a haploid number of 21, with the exception of *H. sapho* and *H. congener* (at one time thought to be conspecific), which both have exceptionally high numbers. The other subgenera within the genus *Heliconius* have chromosome numbers greater than 21. *Eueides* has a haploid number of 31 to 33, and *Laparus* (represented by one species, *doris*) and the unnamed subgenus containing *H. aoede* have haploid numbers between 23 and 27. These last two subgenera were tentatively separated from *Heliconius* (*Heliconius*) by Turner (1968b), by the morphology of their pupae.

Four of the other genera, *Agraulis, Dione, Dryas,* and *Dryadula,* frequently placed in one genus before Michener's revision of the group (Michener, 1942), resemble *H.* (*Eueides*) with n = 31. *Philaethria* is like *Heliconius* (*Heliconius*) in having n = 21. *Podotricha* has one species with a number slightly below 31 (i.e. 28-29) and another with an exceptionally low number (8-10), which approaches the lowest

Table 1. Haploid Chromosome Numbers of the Trinidadian Heliconiine Butterflies (New Data), with Data from other Areas (de Lesse, 1967, 1970a, 1970b; Maeki and Remington, 1961; Emmel, 1969) for Comparison

Species	Trinidad ♂	Trinidad ♀	Guyane	Colombia	Bolivia* or Ecuador†	Argentina	México** or Guatemala†† or Costa Rica‡‡
Agraulis vanillae	31	–	–	–	–	31	–
Dione juno	31	–	–	–	31*†	31	31**
Dryas iulia	31	–	31	31	–	31	31**
Dryadula phaetusa	–	31	–	–	–	31	–
Philaethria dido	21	–	–	–	–	–	–
Heliconius isabella	30–31	–	–	31	–	–	31**
H. aliphera	–	30, 31	–	–	–	31	–
H. doris	–	26–27		24–25, 26, 27	–	–	–
H. ethilla	21	21	–	–	–	–	–
H. melpomene	21	21	21‡	21	21†	–	21‡‡
H. erato	21	21	21§	21	21*	21	21**††
H. sara	21	21	21	21	21†	–	–
H. ricini	21	21	–	–	–	–	–
H. wallacei	21	–	21	–	–	–	–

‡ Lower-Amazonian subspecies, with a slight hybrid admixture from the Colombian-Trinidadian subspecies.

§ Both the lower-Amazonian and Colombian-Trinidadian subspecies.

Numbers separated by a hyphen are found in the same individual; numbers separated by a comma are found in different individuals.

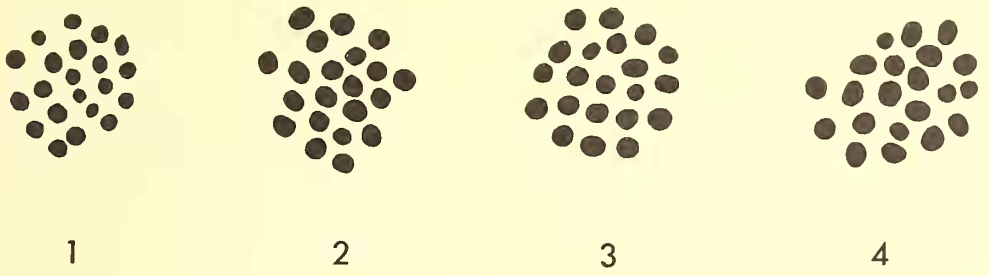

FIGURE 1. *Philaethria dido.* Secondary spermatocyte metaphase.

FIGURES 2–4. Primary spermatocyte metaphases.

FIGURE 2. *Heliconius ethilla.*

FIGURE 3. *H. ricini.*

FIGURE 4. *H. wallacei.* Magnification on all figures × 4000.

haploid number known in the Lepidoptera (*Erebia tyndarus* has 8—Lorkovic, 1949; *Agathymus aryxna* has 5; and three other *Agathymus* have 9—Freeman, 1970). The haploid number 31 is very common in the Nymphalidae, of which the Heliconiines are members, and is the commonest number in the Lepidoptera (Suomalainen, 1969).

The chromosome numbers show themselves to be very much in accord with the taxonomy of the subfamily as determined by the morphology of the adults and pupae (Emsley, 1963; Turner, 1968b; Brown and Mielke, 1971). Most of the genera and subgenera have retained the haploid number of the majority of Lepidoptera (n = 29-32), but the widespread and numerous group *Heliconius* (*Heliconius*) has stabilized, as Suomalainen (1969) points out, round a new number of n = 21. It is interesting that the species with the typical Nymphalid number of 31 include those which have deviated least from the Nymphalids in wing-shape and coloring.

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TABLE 2. CLASSIFICATION OF THE HELICONIINAE BY CHROMOSOME NUMBERS IN RELATION TO THE "NORMAL" NUMBER FOR LEPIDOPTERA (n = 29 – 32)
(DATA FROM PRESENT PAPER, MAEKI AND REMINGTON (1961), AND DE LESSE (1967, 1970a, 1970b)

HIGH CHROMOSOME NUMBER	
n = 56	*Heliconius* (*Heliconius*) *sapho* (Drury)
n = 33	*H.* (*H.*) *congener* Weymer
n = 32–33	*H.* (*Eueides*) *lybia* (Fabricius)
NORMAL CHROMOSOME NUMBER	
n = 31	*Agraulis vanillae* (L.)
	Dione juno (Cramer)
	Dryas iulia (Fabricius)
	Dryadula phaetusa (L.)
	Heliconius (*Eueides*) *aliphera* (Godart)
	H. (*E.*) *isabella* (Cramer)
n = 28–29	*Podotricha telesiphe* (Hewitson)
LOW CHROMOSOME NUMBER	
n = 24–27	*Heliconius* (*Laparus*) *doris* (L.)
n = 23	*Heliconius* (–) *aoede* (Hübner)
n = 21	*Philaethria dido* (Clerck)
	Heliconius (*Heliconius*) *melpomene* (L.)
	H. (*H.*) *timareta* (Hewitson)
	H. (*H.*) *elevatus* Nöldner
	H. (*H.*) *cydno* (Doubleday)
	H. (*H.*) *ethilla* (Godart)
	H. (*H.*) *hecale* (Fabricius)*
	H. (*H.*) *ismenius* (Latreille)†
	H. (*H.*) *erato* (L.)
	H. (*H.*) *ricini* (L.)
	H. (*H.*) *hortense* (Guérin-Meneville)
	H. (*H.*) *charitonia* (L.)
	H. (*H.*) *sara* (Fabricius)
	H. (*H.*) *clysonymus* Latreille
	H. (*H.*) *atthis* (Doubleday)
	H. (*H.*) *telesiphe* (Doubleday)
	H. (*H.*) *wallacei* Reakirt
n = 8–10	*Podotricha euchroia* (Doubleday)

* From Colombia; identified by de Lesse (1967) as *H. ethilla* (see text).

† From México; identified by de Lesse (1970a) as *H. numata telchinia,* and attributed to the species *ismenius* from the studies of K. S. Brown, Jr. (personal communication).

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Summary

1. Haploid chromosome numbers are given for all 14 species of Heliconiine butterflies found in Trinidad. Eleven of these have also been investigated in other parts of their range, and none shows any geographical variation in chromosome number.

2. The great geographical variation in color of *Heliconius melpomene* and *H. erato* is not accompanied by any variation in chromosome numbers.

3. Most of the genera and subgenera have numbers between 28 and 31, which are typical of Lepidoptera, but the very successful subgenus *Heliconius* (*Heliconius*) has, with a few exceptions, a haploid number of n = 21.

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